



Icelandic National Competence Center

HIGH PERFORMANCE COMPUTING & AI FOR DATA SCIENCES & SIMULATIONS

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EuroCC – Introductory Session with NCCs Bulgaria, Cyprus, Iceland, Finland

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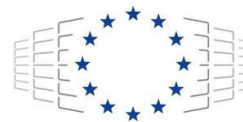
[@MorrisRiedel](#)

Building User Programs under EuroHPC Umbrella (including LUMI)

September 29, 2020
Webinar



EUROPEAN OPEN
SCIENCE CLOUD



EuroHPC
Joint Undertaking



UNIVERSITY OF ICELAND
SCHOOL OF ENGINEERING AND NATURAL SCIENCES
FACULTY OF INDUSTRIAL ENGINEERING,
MECHANICAL ENGINEERING AND COMPUTER SCIENCE



JÜLICH
SUPERCOMPUTING
CENTRE



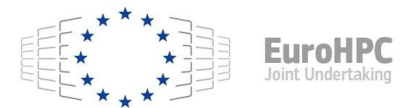
HELMHOLTZAI | ARTIFICIAL INTELLIGENCE
COOPERATION UNIT

Leading Icelandic NCC - Prof. Dr. – Ing. Morris Riedel (since ~2004 in HPC)

- Holds **PhD in Computer Science** (from Karlsruhe Institute of Tech.)
 - MSc in data visualization and steering of HPC & Grid applications
- Over the time many Positions at **Juelich Supercomputing Centre, Germany**
 - OS, Grid divisions; later deputy division leader federated systems and data
 - Currently: Research Group Leader – High Productivity Data Processing
- **Selected other recent activities**
 - Working with CERN & LHC & Grid/Cloud (Strategic Director of EU Middleware)
 - Architect of Extreme Science and Engineering Discovery Environment XSEDE (US HPC Infrastructure)
 - Co-Design of European Data Infrastructure (EUDAT), Research Data Alliance Big Data (Analytics) Chair, DEEP-EST HPC design, steering group of Helmholtz Artificial Intelligence Initiative
 - European EuroHPC Joint Undertaking Governing Board member for Iceland
- **University courses**
 - **University of Iceland Courses: HPC A / B, Statistical Data Mining, Cloud Computing & Big Data**
 - **YouTube Lectures & Slides on Web page**



[1] Morris Riedel Web page



[2] EuroHPC Joint Undertaking

University of Iceland – School of Natural Sciences & Engineering (SENS)

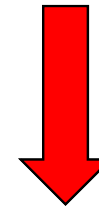
■ Selected Facts

- Ranked *among the top 300 universities in the world* (by Times Higher Education)
- Ranked *#6 in the field of remote sensing* (by Shanghai list)
- ~2900 students at the SENS school
- Long collaboration with Forschungszentrum Juelich
- ~350 MS students & ~150 PhD students
- Many foreign & Erasmus students
- English courses & Several EC Projects in HPC & AI

[3] University of Iceland SENS Web Page



[4] EuroCC Project



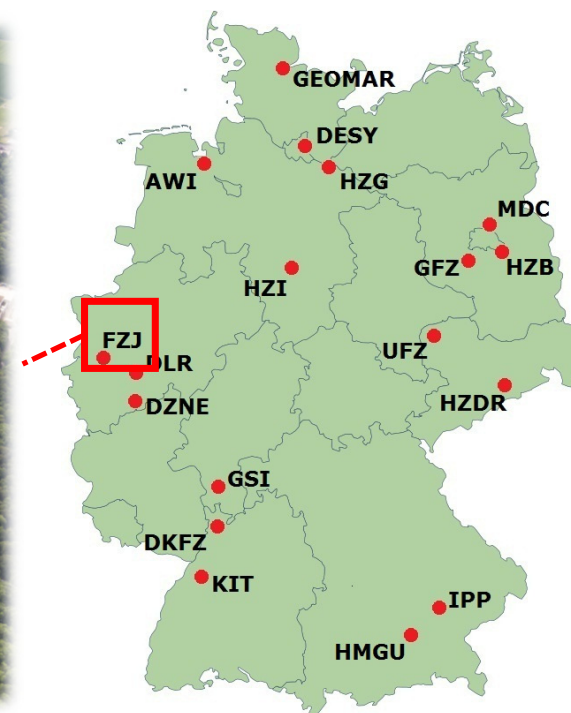
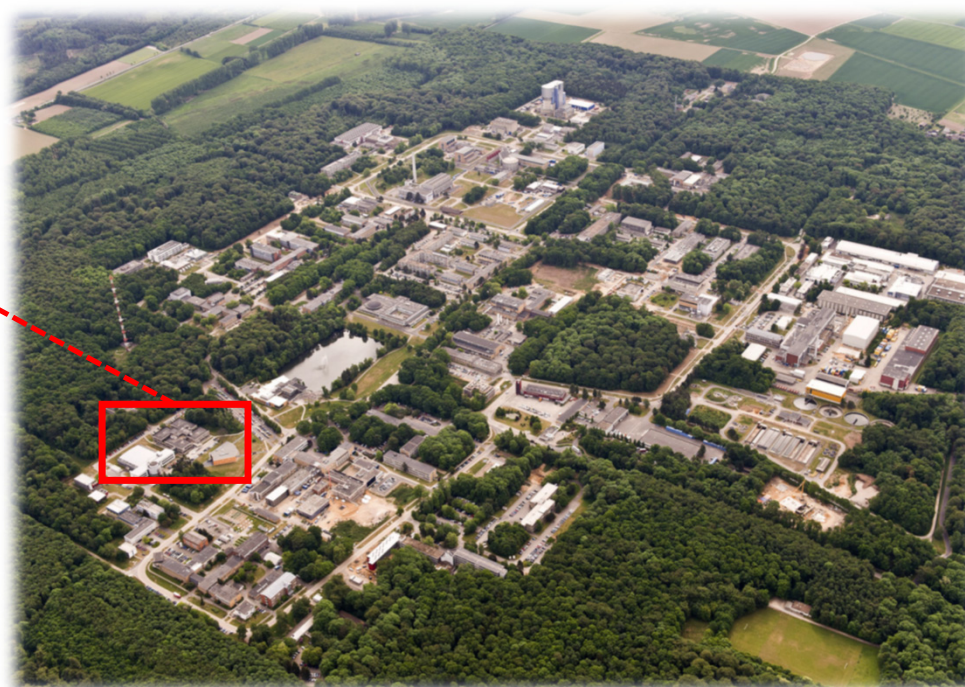
- One strong 'application pillar' in EuroCC & the Icelandic NCC will be engineering in general and 'remote sensing' in particular



Strong Collaboration with Juelich Supercomputing Centre in Germany



[10] Forschungszentrum Juelich Web page



Selected Facts

- One of EU largest inter-disciplinary research centres (~5000 employees)
- Special expertise in physics, materials science, nanotechnology, neuroscience and medicine & information technology

[11] Helmholtz Association

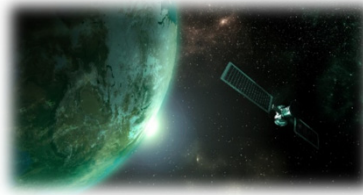
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RESEARCH FOR GRAND CHALLENGES

[17] Helmholtz AI

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DEEP Series of Projects – Modular Supercomputing Architecture Research



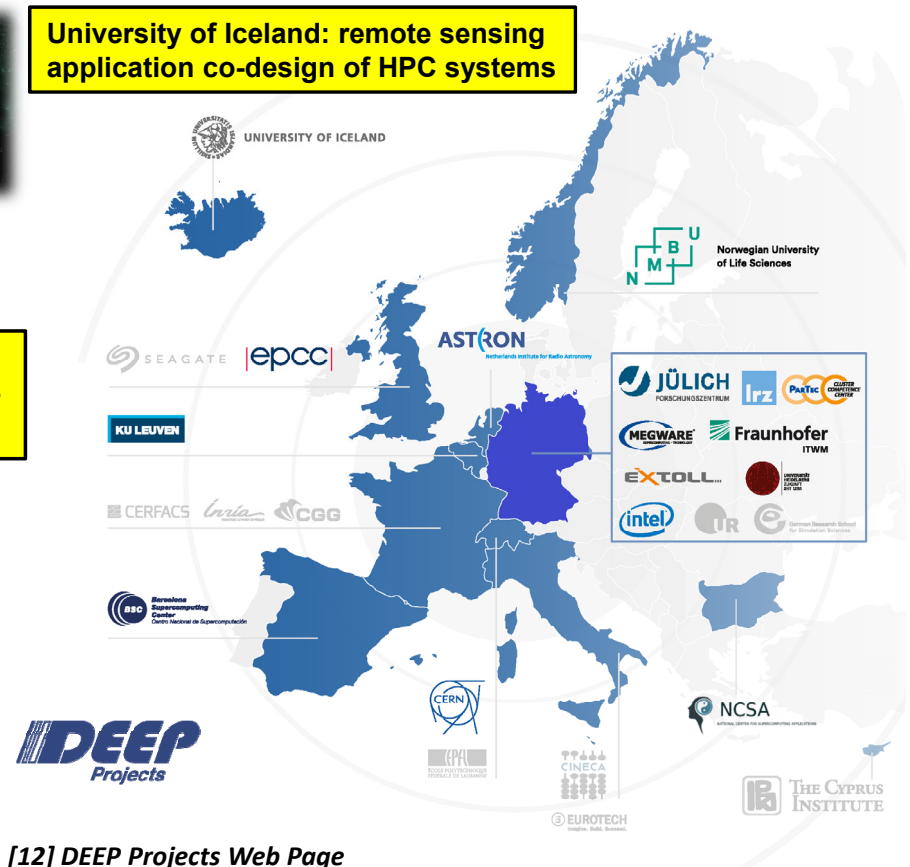
University of Iceland: remote sensing application co-design of HPC systems

Strong collaboration with our industry partners Intel, Extoll & Megware

Strong collaboration with industry partners Intel, Extoll & Megware

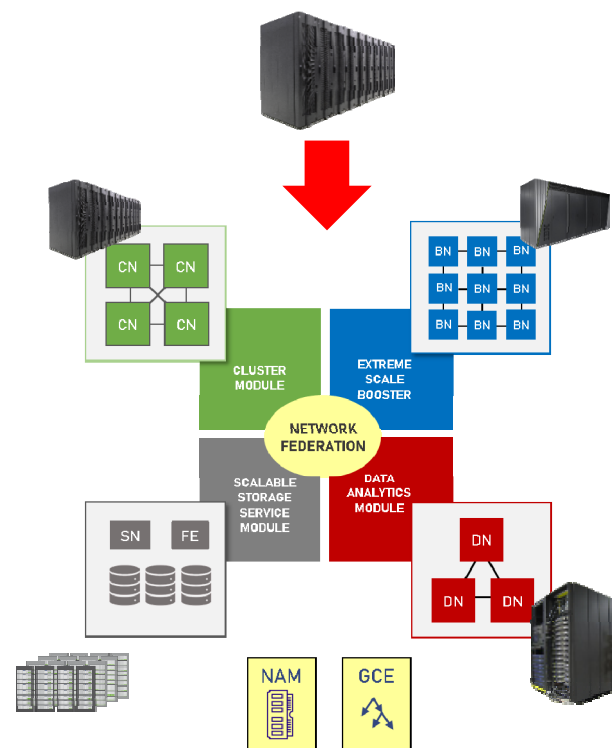
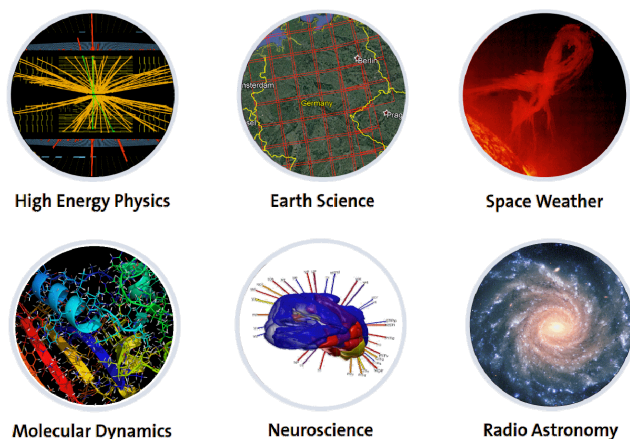
Juelich Supercomputing Centre implements the DEEP projects designs in its HPC infrastructure

- 3 EU Exascale projects
DEEP, DEEP-ER, DEEP-EST
- 27 partners
Coordinated by JSC
- EU-funding: 30 M€
JSC-part > 5,3 M€
- Nov 2011 – Dec 2020

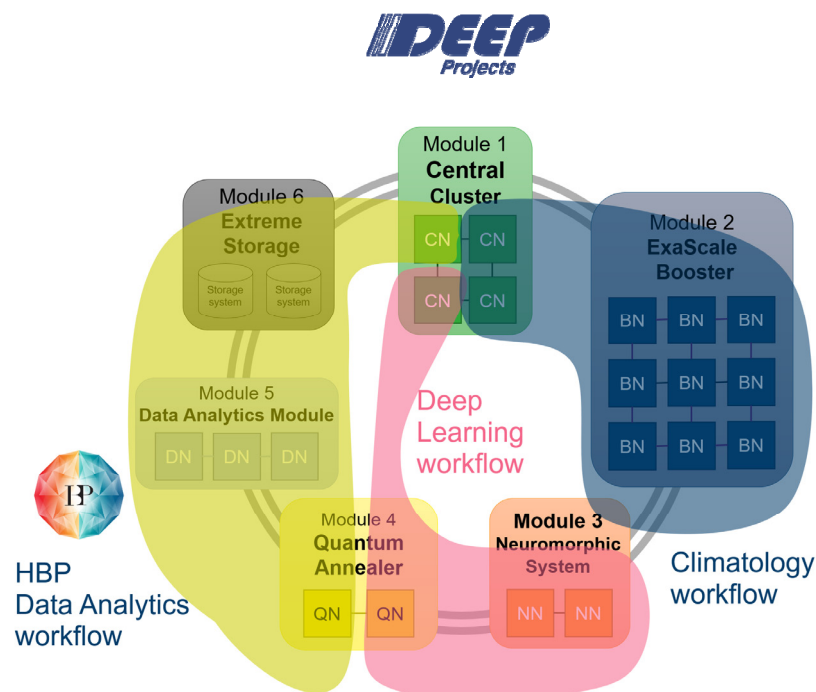


[12] DEEP Projects Web Page

Remote Sensing Application Co-Design for Machine & Deep Learning in HPC



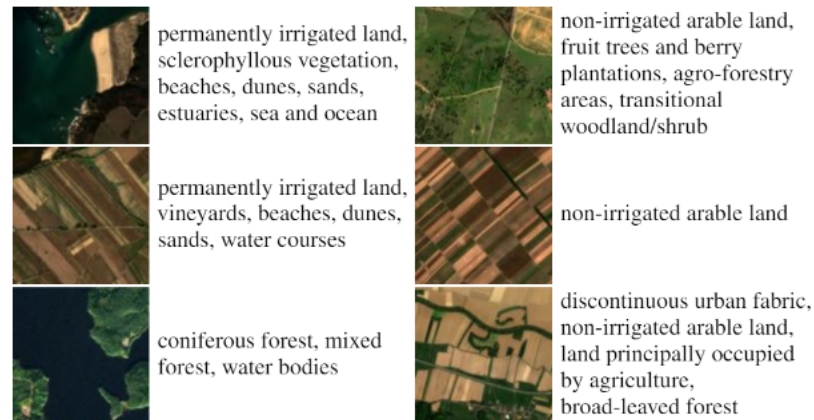
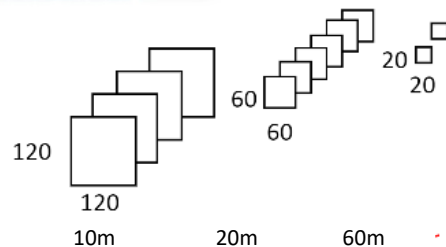
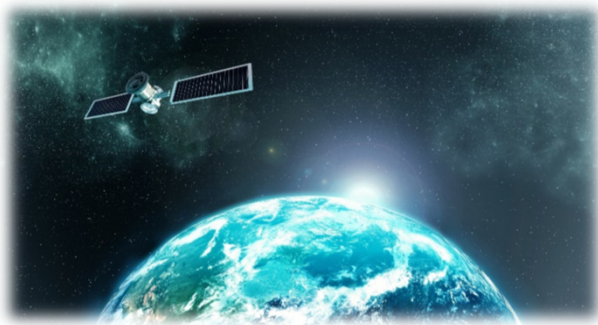
- The modular supercomputing architecture (MSA) enables a flexible HPC system design co-designed by the need of different application workflows



[12] DEEP Projects Web Page

Remote Sensing Example: Multispectral Remote Sensing Dataset Example

Datasets	Image type	Image per class	Scene classes	Annotation type	Total images	Spatial resolution (m)	Image sizes	Year	Ref.
BigEarthNet	Satellite MS	328 to 217119	43	Multi label	590,326	10 20 60	120x120 60x60 20x20	2018	[9] G. Sumbul et al.



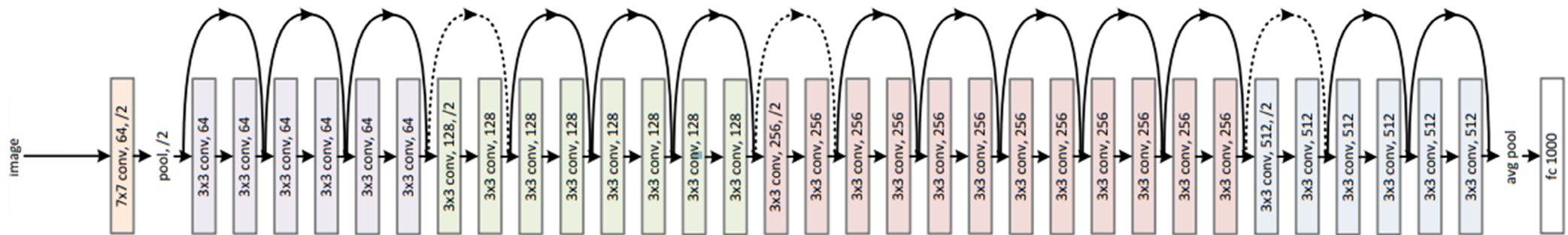
[13] G. Sumbul et al.

[14] Big Earth Net Dataset

[15] R. Sedona & M. Riedel et al., MDPI, Journal of Remote Sensing

More Computation: Deep Learning via RESNET-50 Architecture

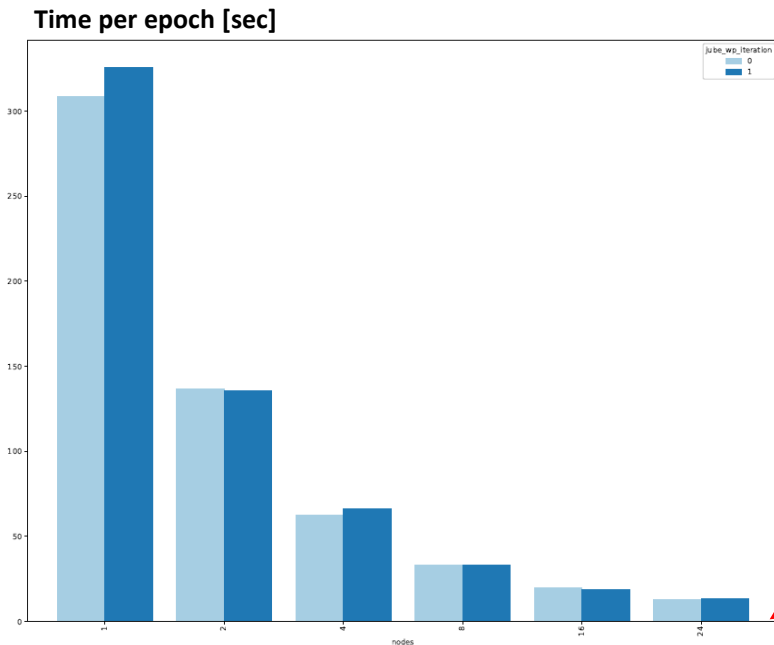
- Classification of land cover in scenes
 - Very suitable for parallelization via distributed training on multi GPUs



[14] RESNET

- RESNET-50 is a known neural network architecture that has established a strong baseline in terms of accuracy
- The computational complexity of training the RESNET-50 architecture relies in the fact that it has ~ 25.6 millions of trainable parameters
- RESNET-50 still represents a good trade-off between accuracy, depth and number of parameters
- The setup of RESNET-50 makes it very suitable for parallelization via distributed training on multi GPUs

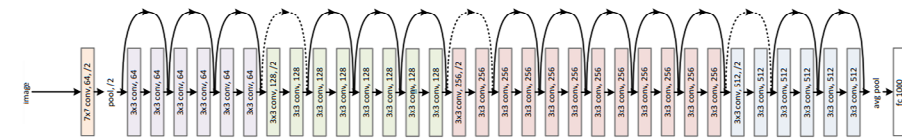
Distributed Training via Multi GPUs with Horovod – Remote Sensing Example



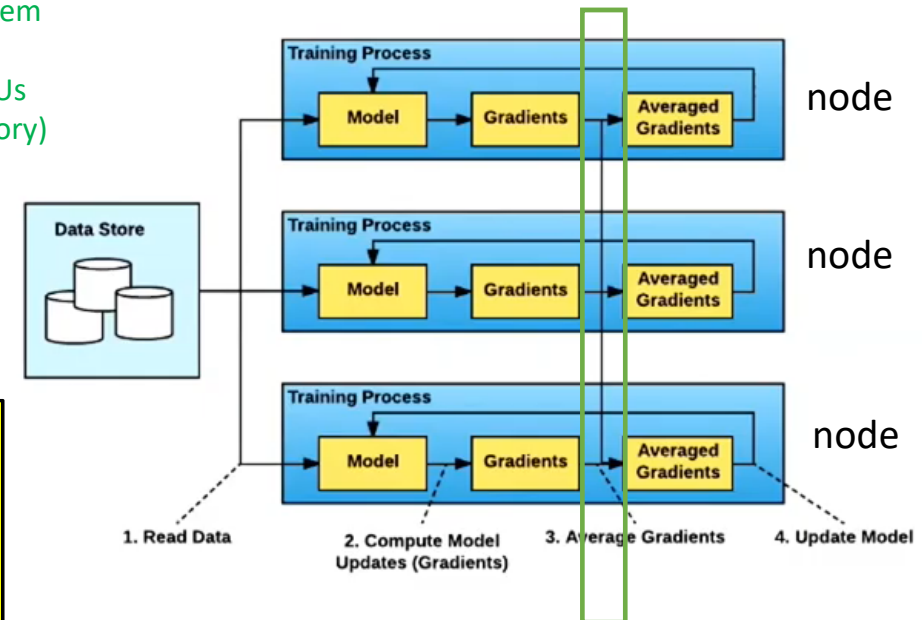
A partition of the JUWELS system has 56 compute nodes, each with 4 NVIDIA V100 GPUs (equipped with 16 GB of memory)

24 nodes x 4 GPUs = 96 GPUs

- Horovod is a distributed training framework used in combination with low-level deep learning frameworks like Tensorflow
- Horovod uses MPI for inter-process communication, e.g., `MPI_Allreduce()`
- Distributed training using data parallelism approach means: (1) Gradients for different batches of data are calculated separately on each node; (2) But averaged across nodes to apply consistent updated to the deep learning model in each node



[14] RESNET



[15] R. Sedona & M. Riedel et al., MDPI, Journal of Remote Sensing

`MPI_Allreduce()`

[16] Horovod

Icelandic HPC Efforts with Long Tradition – But HPC Community ‘Unstructured’

- IHPH Community Web page
 - Central Information ([not often updated](#))
- HPC Funding
 - ‘Tier 2 HPC System’ for research mainly in university & academic ecosystem
 - [National funding: Icelandic Centre for Research \(Rannis\) proposals](#)
 - No strategic long-term perspective yet
 - [Positive: Rannis recognizes needs & funds periodically ~1-2 year iterations](#)



[4] EuroCC Project

- One goal of the Icelandic NCC is to prepare a more structured roadmap of obtaining national funds for HPC resources used by user communities

EuroCC – Introductory Session with NCCs Bulgaria, Cyprus, Iceland, Finland

IHPH

In operation ▾ Support Community History Acknowledgements Hafðu samband – Contact us

Garpur

About

Garpur is a joint project between the University of Iceland and University of Reykjavík with funding from the Icelandic Centre for Research (Rannis). Research topics of computations performed on Garpur ranges from transport in quantum wires to ice sheet modeling of glaciers. Garpur was opened for users in late April 2016. [Here is the original press release.](#)

In late 2017 Garpur recieved and upgrade which more that doubled the performance of the cluster.

Hardware Configuration

Garpur at a glance

[9] IHPH Community



START ACTIVITIES FUNDING AND INTERNATIONAL EVENTS AND AWARDS



[18] Rannis Web page

Icelandic National Competence Center driven by EuroCC including LUMI Activities

- **Community building for users** (Icelandic kick-off in October)

- User programs created broader than LUMI, including industry (e.g., deCODE security requirements for health sector research)

- European **EuroHPC** Joint Undertaking

- **EU EuroCC project** in Iceland: user support & structuring of High Performance Computing (HPC) communities & roadmaps

- **EU ADMIRE Project:** Remote Sensing application co-design of HPC systems

- Links to European Open Science Cloud (EOSC)

- Provides services and tools for large-scale datasets (aka 'big data') for EU researchers
- Offers computing capacity for scientists in EU
- **EU EOSC-Nordic project** in Iceland: provisioning of a couple of data services for selected application communities in Iceland

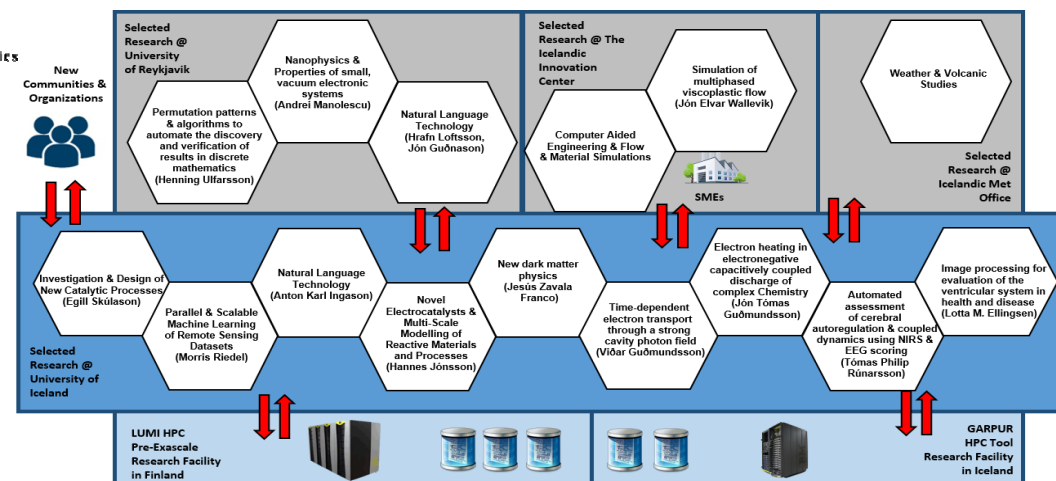
[2] EuroHPC Joint Undertaking



[71] deCODE

[5] EOSC Web page

[6] EOSC-Nordic Web page



[8] *LUMI Web page*

Icelandic High Performance Computing (IHPC) Expert Network as Iceland Competence Centre

Current Status towards an Icelandic NCC

WP 33 Tasks (currently all led by Morris Riedel)

- Task 33.1 (National Competence Centre) - Management
- Task 33.2 Training and Skills Development
- Task 33.3 Technology Transfer/Business Development
- Task 33.4 Collaboration with Industry
- Task 33.5 Mapping of HPC/Big Data/AI Technical Competences (in the respective state)
- Task 33.6 Facilitation of access to scientific and technical expertise and knowledge pools
- Task 33.7 Awareness Creation and Collaboration

▪ Kick-off event planned with all RANNIS proposal HPC user communities and the LUMI Icelandic Steering Committee

▪ Initial meeting with deCode genetics leads to common interest in HPC technology & skillset exchange, particularly also observing advancements in Quantum Computing



[7] deCODE

▪ Started collection of user communities to be better structured apart from a RANNIS proposal approach

- Meeting last week with the University of Iceland Project Management Office & Dissemination Office
- Ph.D. Student 'Reza' funded to support activities for collaboration in EuroCC



[4] EuroCC Project

Next Steps towards an Icelandic NCC – Task Activities (1)



■ Task 33.1 (National Competence Centre) - Management

- Steering Board of Icelandic NCC to be formed and name agreed to; Links to LUMI
- Champions discussions (quite not the Icelandic way, it's a community/experts view)

■ Task 33.2 Training and Skills Development

- Teaching in University on HPC and Cloud Computing as well as Machine Learning available
- Problematic: using the tax-payer funded HPC systems not directly possible for Industry
- Survey of what training is needed in the Icelandic commercial and industry realm
- Survey what training is needed with the ~17 user communities

■ Task 33.3 Technology Transfer/Business Development

- Exploring Icelandic startup in Quantum Computing and links to other interested parties
- Meeting planned with Icelandic Startup Center at the University of Iceland

■ Task 33.4 Collaboration with Industry

- Focus on deCode Genetics, but Marel Food processing industry next approach (initial discussions good)

Next Steps towards an Icelandic NCC – Task Activities (2)

■ Task 33.5 Mapping of HPC/Big Data/AI Technical Competences

- Each of the ~17 user communities have already competences in HPC & AI
- Known libraries are used in specific science domains

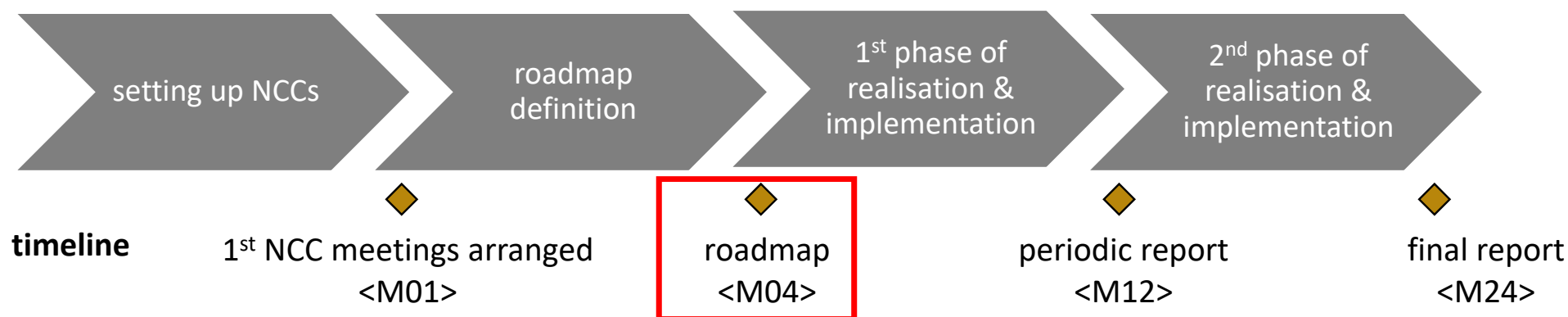


■ Task 33.6 Facilitation of access to scientific & technical expertise and knowledge pools

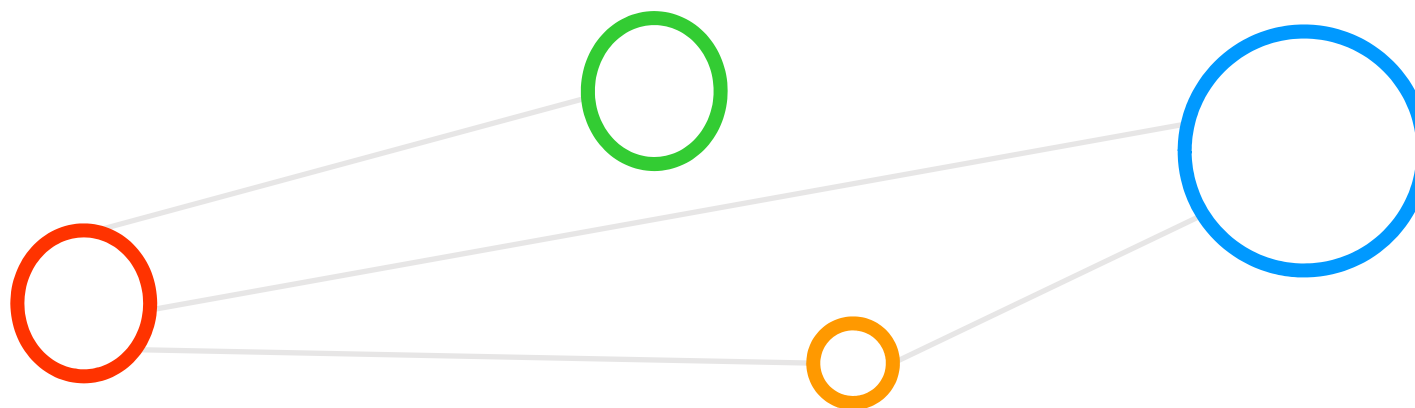
- Complete makeover of IHPC Web page with community accounts

■ Work towards ‘Roadmap’ Milestone M2 & Deliverable D33.1 (all WP33 tasks involved)

- Rannis proposal serves as first base & IHPC community; discussions with all ~17 science proposal members
- Explore work with the USA as well: Arctic Supercomputing Forum & Quantum Computing Research



References



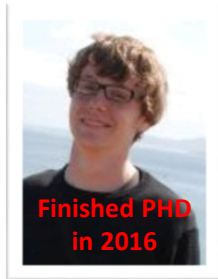
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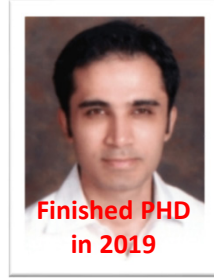
Acknowledgements – High Productivity Data Processing Research Group



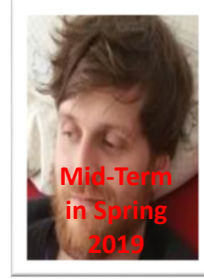
PD Dr.
G. Cavallaro



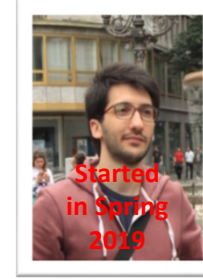
Senior PhD
Student A.S. Memon



Senior PhD
Student M.S. Memon



PhD Student
E. Erlingsson



PhD Student
S. Bakarar



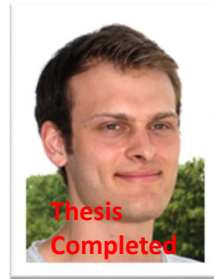
PhD Student
R. Sedona



Dr. M. Goetz
(now KIT)



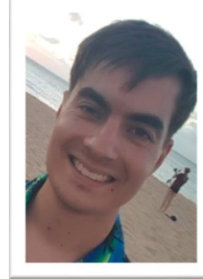
MSc M.
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